

Climate Change, Strategic planning, and Impact of IoT and AI assisted Home Automated and Smart Agricultural Novel Systems

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Abstract

Climate Change, Monsoon Pattern Change, lack of labour, rising labour and farming cost, crop failures linked to unforeseen production caused by diseases, soil degradation, and as well as rapidly changing market prices in agricultural products are the main Challenges. Strategic planning, use of Novel Systems, and Home automation are the solutions to adversely impacting agricultural development with new future possibilities for better Human Civilization. Home automated Novel Systems having alert and notifications features incorporate strategic planning and are intelligent, effective, and efficient with many more features is also useful for the Agriculture sector. The marketplace needs massive food, and current agricultural modernization approaches call for substantial energy inputs. Economic factors play a vital role. On the other hand, increased demand for food cereals as a result of population growth has led to an increase in the cost of agricultural commodities. Internet of things (IoT) and Artificial Intelligence (AI) have changed trends in Smart Agriculture. IoT and AI assisted Home Automated and Smart Agricultural Novel Systems created new future possibilities, and helps in strategic planning and impacting from Home Automation with alerts and notifications to large agriculture fields in a positive way by working as Executive Decision Support System (EDSS). It also has the potential to minimise farmer losses, produce high yield, significantly raise the quality of produced food, lower labour costs, boosts farmer incomes, and fully achieve agricultural modernization are the important features of Novel Systems with IoT and AI assisted clever agricultural techniques along with increasing agricultural

productivity and helps for Global Economy and food security for Nations. The goal of the current research paper is to review various recent trends and explore new future possibilities, strategic planning, and the Impact of IoT and AI assisted Home Automated and Smart Agricultural Novel Systems in Climate Change and Monsoon Pattern Change scenarios.

Keywords: Climate Change, Internet of Things, Artificial Intelligence, Smart Agriculture, Economy, Home Automation, Executive Decision Support System

1. Introduction

The agricultural sector contributes significantly to the Global economy. The primary worry and contentious issue globally is the automation of agriculture. One-third population out of 7.96 billion World population is hunger-starving due to uneven food production and distribution in 195 countries of the world.

Climate Change, and Monsoon Pattern Change adversely impacting on agricultural development, hence needs Strategic planning, use of Novel Systems, and Home Automation with alerts and notifications to deal with the challenges.

Any action of planning to achieve the desired goal is nothing but strategy. Strategic planning is nothing but a logical process that commonly holds the definition of strategic purposes, short, medium, and long-term goals, and broad plans to achieve them.

Home automation is nothing but the auto-electronic control system with domestic features, action, and utilisations. Novel Systems are nothing but equipment or machines which are new and unusual kind and work in a different way than was known before or have a novel idea or approach. Novel Systems with combine technologies such as the Internet of Things (IoT), Artificial Intelligence (AI), Wireless Sensor Networks (WSNs), Cloud Computing, Middleware, and so on for a particular goal such as Smart agriculture and many more applications. Home automated Novel Systems having alert and notifications features incorporate strategic planning and are intelligent, effective, and efficient with many more features is also useful for the Agriculture sector.

The IoT is a lattice of intelligent apparatus, parameter sensors, and analysing systems that interconnect and interact with each other without human interventions and sometimes, or in some cases with human snooping. AI is nothing but a reduplication of a human brain with the provision of instruments or computers.

WSNs are nothing but a group of spatially spread and accurate sensors and self-configured and infrastructure-less wireless networks to monitor physical or environmental conditions, and jointly passing on such data through a wireless network to an internet-based location is an important part of IoT.

Cloud Computing provides the facility of using a network of remote servers hosted on the internet to store, access, manage, and process data, rather than a local server or a personal computer. Middleware systems having capabilities of software that works in between Operating System (OS) and applications running on it for information-exchange and management and support and mobile applications are some of the most impressive technologies that are integrated with IoT to develop farming remedies.

The population is growing rapidly, and with it, so is the need for food and work. Farmers have been employing traditional methods, but they were insufficient to meet these demands. New automated systems were consequently developed. These innovative techniques supplied the world's food needs while simultaneously giving huge numbers of people access to jobs. Advancement in agriculture has been initiated by Artificial Intelligence (AI). The crop yield has been covered by this technique from several circumstances, including population expansion, job issues, and food security concerns [1].

There are several AI uses in agriculture, including irrigation, harvesting, and sprinkling using sensors and other tools built into robotics and drones. These tools reduce the overuse of irrigation, herbicides, and pesticides, preserve soil fertility, assist in the effective use of labour, increase output, and improve product quality [2].

The impact of AI and IoT based systems is important in the agricultural sector to effectively navigate, monitor, analyse, and intelligently identify agricultural activities and commodities. Implementation of such smart agricultural systems can recognise, manage, and operate a variety of agricultural aspects in a more sophisticated and interactive manner. It can also significantly improve humans' comprehension of the crucial aspects of the lives of agricultural living things, aid in their capacity to handle complicated agricultural systems and help them deal with various agricultural crises. Agriculture-related IoT technology is currently the subject of considerable and active research globally, but most applications are still at the experimental demonstration level [2, 3].

Using IoT and AI assist in collecting sensor data, processing it, and identifying basic factors that subsequently aid in crop yields. Some of the aspects that are taken into account in the growing of crops are temperature, soil management, weed control, crop disease detection, crop health monitoring, and rainfall forecast [3].

IoT and AI have made significant contributions to every field, including automated irrigation systems, agricultural monitoring models, demand and supply data analytics, crop prognostication with image processing, and the precise application of pesticides with the aid of sensors [4, 5]. With the adoption of numerous contemporary methods, there remain numerous issues that need to be resolved to improve farming.

The goal of the current research paper is to review various recent trends and explore new future possibilities, strategic planning and the Impact of IoT and AI assisted Home Automated and Smart Agricultural Novel Systems in Climate Change and Monsoon Pattern Change scenarios.

1.1 Implementation of IoT and AI in the Agriculture Field

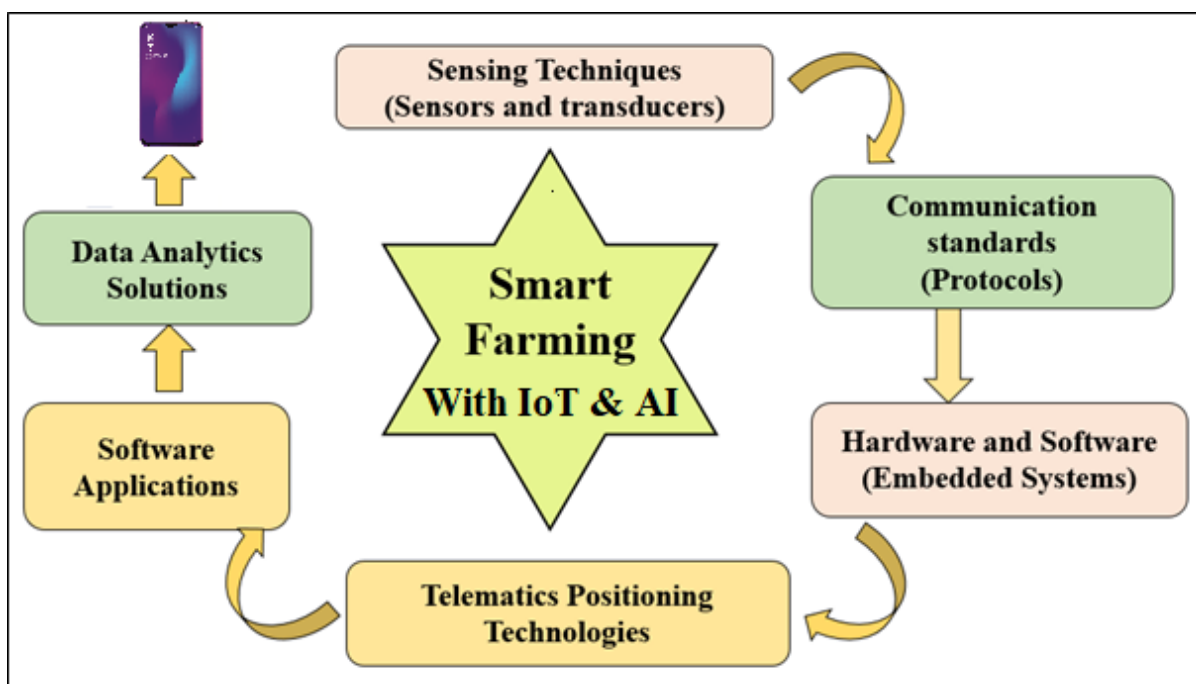
Since there have been numerous technological advances in farming, it is now much more industrialised and future technologies than it was decades back. Nowadays, we can observe farmers effectively adopting Smart Agriculture, which gives them more influence over the process of producing livestock and growing crops. Systems for tracking cattle, agricultural robots, intelligent greenhouses, and intelligent pest control are all available. It becomes increasingly dependable and effective as a consequence [5, 6]. Smart and precision farming using digital advancement are emerging technologies that are being introduced into farming regularly through new methodologies, instruments, and approaches.

1.2 Concept of Smart Farming

The advent of agriculture can be seen as Smart Agriculture. It is a fascinating approach that uses cutting-edge technologies like robotics, unmanned aerial vehicles, IoT and AI, and other technologies to improve farm management. The purpose of smart farming is to increase product quantity and quality while maximising human labour and other necessary resources. Farmers may more readily monitor their farms from a remote distance and make strategic decisions by incorporating modern technologies [6].

Figure 1 summarises the application of IoT and AI that are now accessible to farmers, including the implantation of sensors in farms, the use of specialist software, connection, and location-based concepts, analytics of data, etc.

Figure 1: Summary of Application of IoT and AI in Smart Agriculture



2. Literature Survey

The significant progress that has been established in the agricultural field using IoT and AI is covered in this section.

A harvesting planning system based on the integration of crop assignment and vehicle route is described by Plessen, M.G. et al. [7] Because of these new technologies, labour, which was once limited to a small number of industrial sectors, is now involved in many other industries. The wide fields of biology, computer science, maths, psychology, and technology form the foundation of artificial intelligence.

Jha, K. et al. [8] provided a quick review of how agricultural automation is currently being used. The report also discusses a suggested IoT-based approach for irrigation and identifying flowers and leaves at the botanical farm.

Bannerjee, G. et al. [9] offered an in-depth analysis of the tools and equipment powered by AI that have raised the bar for farming. Highlights of a thriving expansion as well as a positive outlook for use in agriculture.

Naganur, H.G. et al. [10] reported Smart farming, a word that is frequently used, is a transformation in the agricultural industry that allows for the resolution of numerous regional and worldwide difficulties. By lowering the danger of crop failure and improving the overall quality of the yield, the use of contemporary technologies in agriculture is generating enormous revenue.

Liakos, K.G. et al. [11] in the agro-based sector, it has been widely reported that the latest automated systems incorporating agricultural robots and drones have greatly benefited. Several high-tech computer-based systems are meant to identify essential characteristics including weed detection, productivity identification, crop quality, and many more ways.

Kumar G. et al. [12] address several irrigation techniques to develop a system that uses fewer resources and is more effective. On the field, instruments like fertility meters and pH meters (which measures the acidity or basicity of liquid) are put up to measure the proportion of the soil's main constituents, such as potassium, phosphorous, and nitrogen. Drip irrigation is used to automatically plant irrigators on the field using wireless technology. This technique enhanced the soil's fertility and the efficient use of water resources.

Jha, K. et al. [13] designed an automated irrigation system using Arduino to decrease the labour and time required for irrigation. Machine learning will help to farm is illustrated by the filtering and categorization of the items that are given. Agricultural production systems are transforming into real-time operated intelligent programs that offer specific advice and perspectives for farmer decision-making and action by employing machine learning to sensor data.

Shekhar, Y. et al. [14] by employing embedded system platforms such as Arduino and Raspberry Pi 3, a robotic model for automatic sensing of temperature and moisture content was developed. According to the need, the resource will provide water, and it will also monitor and record sensor readings.

Reinecke, M. et al. [15] addressed the advantages of drones in agriculture as well as their drawbacks, using real-world examples to show how they work on farms. They talked about the various benefits of drones, in particular how they help farmers increase their harvest by spotting issues early and controlling the crops by utilizing particular cameras to spot pests and droughts.

Furukawa et al. [16] revealed how to analyze corn crops with unmanned aerial vehicles. The measurement of corn height is done with the use of 3D photogrammetry. Remote sensing has many applications in the territory of smart agriculture.

Hirsch et al. [17] proved an appropriate IoT ecosystem for tracking soil temperature and moisture both at home and on a farm. IoT-based low-power design has also given serious consideration to how environmental factors affect plant growth.

Severino, G. et al. [18] envisaged a network of a sensors-based intelligent system. This network measures the concentration of dissolved contaminants and soil moisture, and the suggested model forecasts farm processes. As a result, water irrigation can be adjusted, and even optimization can be extended to other agricultural areas.

Bhatta, N.P. et al. [19] developed a strategy for effective agricultural operations using IoT, AI, and image recognition. Drones are utilized to take pictures of farms and conduct field analysis in real-time. To determine the problem's goal and forecast how crops will behave during various seasons, logic gates and Artificial Neural Networks (ANN) are being used. The answer is both qualitative and quantitative.

Faiçal, B. et al. [20] Implementing Global Positioning System (GPS) which provides users with positioning, navigation, and timing (PNT) services improves the product preparedness process highly effective because every stage can be tracked, increasing efficiency and profit. High-resolution drones benefit from computer vision technologies for precise data gathering, crop productivity, disease detection, and waste reduction. several significant activities carried out by drones in farming. Further technological advancements can shield farms from environmental hazards.

Bhagwat, S. et al. [21] an Android app is being developed for the Smart Green House to monitor the environment inside. Through the app, the user receives the data that the Sensor has collected. Based on values for on/off devices, the proper action will be conducted. By using this application, it is possible to improve crop quality and yield.

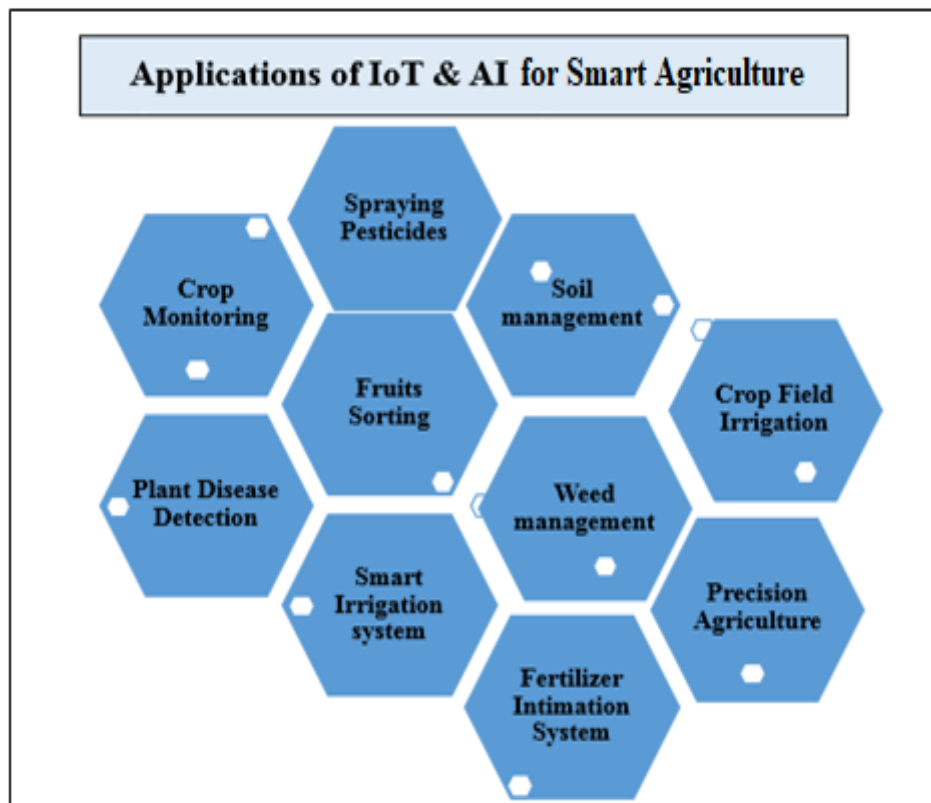
Patra, L. et al. [22] described the architecture of IoT. The authors demonstrate a few possible applications where it can be used. Also describes a few impediments that must be addressed, as well as the security concerns that demand consideration, such as extensive deployment, uniformity, interoperability, data protection, efficient spectrum usages, unique recognition, gathered object safety, confidentiality, and power usage. The development of sensing, actuating, and Radio-Frequency IDentification (RFID) technologies have accelerated the growth of the IoT. It seeks to smoothly integrate the virtual and physical worlds.

Dlodlo, N. et al. [23] Promising IoT applications in farming for sustainable rural growth have been identified in this research paper [2]. In this paper, many commercial prospects related to the agriculture area and the advantages that can be developed utilizing the IoT are described. This paper aims to encourage IoT adoption in rural and agricultural development. Based on the literature, developers can employ IoT to develop nation-specific innovations based on the agriculture industry. The advancement of technology will raise people's standards and aid in the reduction of poverty.

3. Applications of IoT & AI in Agriculture Area

Community agriculture in urban and rural areas takes advantage of hardware and software resources and large amounts of data. Numerous fields, including automated irrigation systems, crop monitoring models, and crop prognostication, benefited tremendously from IoT and AI. The farming method takes into account several factors, including temperature, rainfall prediction, weed control, water quality, soil management, crop health monitoring, and weed control [24-28]. Figure 2 shows the various applications of IoT & AI for Smart Agriculture.

Figure 2: Application of IoT & AI for Smart Agriculture



4. Advantages of IoT and AI for Smart Agriculture

IoT applications comfort farmers by collecting data on crops, weather parameters, and many things. The foundation of AI is the idea that human intelligence can be described in such a way that a computer can readily duplicate it and carry out activities, from the most basic to the most complex. More than just collecting environmental data is possible with IoT. With the appropriate software, weather stations may modify the temperature to meet the necessary criteria and provide the ideal conditions for customized farms. Following are the few advantages of IoT and AI in the agricultural area [27-30].

- Real-time Data collection with the help of installed sensors.
- Risk reduction.
- Improvement of sustainability.
- Business automation.
- Quality Enhancement.
- Livestock monitoring.
- Monitoring Climate Change and weather parameter variation.
- Greenhouses automation.
- Crop diseases monitoring.
- Cost reduction.
- Crop-safety from animals.
- Security from machinery theft.

Conclusion

Strategic planning, Home automation, and the use of Novel Systems are the solutions to adversely impacting agricultural development with new future possibilities for better Human Civilization. Home

automated Novel Systems having alert and notifications features incorporate strategic planning and are intelligent, effective, and efficient with many more features is also useful for the Agriculture sector. A recent trend of various technologies provides wide scope for exploration of new future possibilities. In Climate Change and Monsoon Pattern Change scenario, It also helps for strategic planning and as well as Impacting positively with IoT and AI assisted Home Automated and Smart Agricultural Novel Systems. IoT and AI together enhance the productivity, effectiveness, and efficiency of Smart Agriculture. The utilization of alerts and notifications, and remote sensors, such as those for temperature, humidity, soil moisture, water level sensors, and pH value, will give farmers insight into how to practice accurate and efficient agriculture to overcome field issues. With the aid of IoT and AI, farmers may automate their operations while also switching to precise cultivation for improved crop quality and production while consuming fewer resources. Wireless Sensor Networks (WSNs), Cloud Computing, Middleware systems, and mobile applications are some of the most impressive technologies that are integrated with IoT to develop farming remedies.

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